REMARKS

Applicant thanks the Examiner for the careful review of this application. The specification and figures were amended to correct clerical errors. Claims 1-2, 4 and 6-8 were amended to clarify aspects of the present invention. No new matter was added. Claims 1-9 remain pending in this application.

FIGURE OBJECTIONS

Figures 1-2, 6 and 9 were objected to by the Examiner. Specifically, the Examiner required for figures 1-2 to be labeled as --Prior Art-- and also required a line 415 to be added to figure 6. For figure 9, the Examiner required a line 911 to be added, a line to be added connecting blocks 909 and 911, a line to be added to connect blocks 901 and 903 and a line added to connect label 903 with block 'phase distributor'.

Figures 1-2, 6 and 9 were updated to address the various objections. Additionally, figure 7 was amended to add label 411 with an indicator line and an indicator line was also added to existing label 412. Replacement figures, that include the corrections, are located at appendix A of this paper. Withdrawal of the figure objections is respectfully requested.

SPECIFICATION OBJECTIONS

The abstract and specification were objected to for various informalities. Applicant has attended to the various specification objections by way of the preceding amendment. Regarding the objection to reference numeral 411 that is mentioned in paragraph [0036] but not on figure 7, Applicant has added reference numeral 411 to figure 7. Regarding the request to correct "circuit,controlled by", Applicant has amended claim 8 to recite --circuit,

controlled by--. Withdrawal of the specification objections is respectfully requested.

REJECTIONS UNDER 35 U.S.C. § 102(b)

Claims 1, 4 and 6 were rejected under 35 U.S.C. § 102(e) as being anticipated by Bergmann (U.S. Patent No. 4,821,297). Claim 9 was rejected under 35 U.S.C. § 102(e) as being anticipated by Hogge (U.S. Patent No. 4,218,771). Applicant respectfully traverses for the following reasons, but reserves the right to swear behind these references at a later date.

Bergman apparently discloses a digital clock recovery scheme. Included is reference clock used to provide a plurality of N signals with different clock phases. The incoming data stream is sampled and clocked with the reference clock to generate a plurality of M samples for each data bit. The logic values of the M samples are then analyzed to determine the relationship between the current clock phase and the data bit transition. If all samples agree, the clock phase is perhaps aligned with the data. If the clock phase is either leading or lagging the data, various samples will disagree. In the latter situation, the clock phase is adjusted until all samples agree, the particular clock which provides this state thus being defined as the recovered clock signal.

Hogge apparently discloses an automatic clock positioning circuit for positioning a clock pulse for a digital data stream that resembles an eye pattern when seen on an oscilloscope in response to digital data when the sweep is equal to the baud, bit or clock rate. Included in the circuit is a timing source for providing a stream of clock pulses and a controllable phase shift means electrically connected to said timing source and in response to an error signal will

either advance, delay or maintain the phase of said stream of clock pulses. Also included is a pseudo-error indicator means for providing an upper, lower, early and late boundary condition within the center of the eye pattern of the digital data stream and providing a first pseudo-error signal for each violation of the upper or lower boundary condition by the eye pattern at the early boundary condition and a second pseudo-error signal for each violation of the upper and lower boundary condition at the late boundary of the eye pattern, means for integrating the first and second error signals, means for comparing the integrated first error signal with the integrated second pseudo-error signal providing an error correcting signal; and means for controlling the controllable phase shift means with the error connecting signal.

Aspects of the claimed embodiment are directed to methods and systems for data recovery for a digital stream of input data such that a plurality of sampling clocks are employed to maintain optimal placement of a 'valid data' region within an eye opening that results from a superposition of multiple data transitions. Each sampling clock of the plurality of sampling clocks is independently and automatically adjusted to maintain optimal placement of the valid data region. For example, the valid data region may need to only be adjusted on the left side due to an asymmetrical jitter distribution. Instead of adjusting the entire valid data region, which would result in the right side of the region being too far over, just a sampling clock that defines the left boundary would be adjusted. This process can also be done for the right boundary or for both boundaries at the same time. Advantageously, the claimed embodiment allows for adjustment of the valid data region, as defined by a leading and trailing clock, as the shape of the jitter distribution changes as well as mere shifts of the center of the distribution to the left or right. This unique behavior of the

claimed embodiment is succinctly described in Applicant's specification at page 10, lines 3-20 and is reproduced here for the Examiner's convenience:

> **"The term `predetermined margin` indicates that the phases of `CLK1` and `CLK3` do not exactly coincide to the edge of the data eye. The data eye is related to the probabillistic distribution of jitter. Furthermore, the phase controller has a low pass filter, which makes the phases of `CLK1` and `CLK3` determined by the past history of random jitters on the data.**
>
> **[0028] In the present invention, `CLK2` 308 is controlled by a phase control signal that is determined from the difference of the bit-error-rate measured at `CLK1` 307 and the one measured at `CLK3` 309. `CLK1` 307 and `CLK3` 309 are advanced and delayed from `CLK2` 308 by the time difference of `TM` 310, respectively. The time difference `TM` 310 is controlled by another phase control signal that is determined from the summation of the two bit-error-rate. If bit-error-rate at `CLK1` 307 is greater than the one at `CLK3` 309, it means that the overall sampling phase leads the eye opening. Therefore, the phase of `CLK2` 308 is delayed until the two bit-error-rate becomes equal. On the contrary, if the bit-error-rate at `CLK1` 307 is smaller, the phase of `CLK2` 308 is advanced. If the sum of the two bit-error-rate exceeds a predetermined value, `TM` 310 is decreased to shrink the sampling window to the eye opening. If the sum is less than predetermined value, `TM` 310 is increased."**

In marked contrast, both Bergman and Hogge disclose methods of maintaining an optimal clock position in an eye of a jitter distribution via fixed valid data regions. That is, the leading and trailing sample clocks that define the valid data region are pre-defined at a set and equal distance on either side of the data clock. If the valid data region, or conversely the eye opening moves, to either side then both Bergman and Hogge will make an adjustment of the valid data region as a whole in the appropriate direction to correct the phase

imbalance. Disadvantageously, both Bergman and Hogge are simply not capable of adjusting the size of their valid data region.

To further illustrate, Applicant respectfully draws the attention of the Examiner to Bergmann, column 3, line 63 to column 4, line 17 that is reproduced here:

> **"Referring to FIG. 2, a timing diagram is shown of incoming data. The clock signal is represented by the vertical lines. The locations of RD1, RD2, and RD3 for each data bit are indicated by their respective numerals in FIG. 2. For this particular example, RD1 may represent the 10% interval of the data bit, RD2 the 50% interval, and RD3 the 90% interval. Other interval values for RD1 and RD3 may be used, for example, 25% and 75%, respectively. In accordance with the teachings of the present invention, however, the middle sample value must be chosen at or near the 50% interval since this position of the data bit will most likely represent the correct data bit value, regardless of the initial misalignment of the clock. Therefore, RD2 is utilized as the retimed data output of recovery arrangement 10. For the particular situation illustrated in FIG. 2, data samples RD1, RD2 and RD3 will always be identical in value, since the phase of the clock is correctly synchronized with the data stream. That is, the RD1-RD2-RD3 inputs to decision circuit 18 will either be " 1-1-1" or "0-0-0." Provided with this input, decision circuit 20 will transmit a "no change" output signal to phase selector 22."**

Bogge's out of phase alignment system is dependent on the spacing of the "RD" marks in the timing diagram. Alignment is achieved when a specific pattern is detected. The "RD" marks can perhaps be adjusted but then that would perhaps require the pattern to be changed accordingly to properly detect alignment. The spacing of the RD marks are not automatically changed in response to a change in the width of the timing pulses.

Hogge also discloses a similar type of system that is dependent on the eye pattern moving out of a specified and fixed window such as that described by Hogge at column 3, lines 36-48:

> **"There is established an upper boundary condition 16 and a lower boundary condition 17 in the eye pattern. The timing pulses .tau..sub.2 as shown by waveform 7 in FIG. 1 establish the early boundary condition 19 while the delayed boundary condition 20 is established by the delayed timing pulses .tau..sub.1 of waveform 11 of FIG. 1. Under ideal conditions, the clock or timing pulses associated with each data bit will occur in the center of the eye pattern. However, when a side 14a, 14b, 14c or 14d of the eye pattern crosses the boundary conditions established by the upper boundary 16, the lower boundary 17, the early clock pulse .tau..sub.2 at 19 or the late clock pulse .tau..sub.1 at 20, then a pseudo-error occurs."**

Bogge specifies that the eye pattern is out of alignment when the upper boundaries 16 and 17 intersects with eye pattern boundaries 14a, 14b, 14c or 14d. No disclosure is made of adjusting these various boundaries in response to a change in the shape of the eye pattern.

Claim 4 depends directly from independent claim 1 and is allowable at least for the reasons set forth for that independent claim. Withdrawal of the rejections of claims 1, 4, 6 and 9 is respectfully requested.

REJECTIONS UNDER 35 U.S.C. § 103(a)

Claims 2-3 and 7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bergmann in view of Hogge. Claims 5 and 8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bergmann in view of Hogge and further in view of Epstein (U. S. Patent No. 3,663,115).

Bergmann and Hogge were previously summarized. Epstein apparently discloses a digital voltage controlled oscillator ("VCO") to produce an output clock having a given repetition frequency comprising a source of the input clock, first means to generate a local clock having a repetition frequency equal to a given multiple L of the nominal value of said given repetition frequency and to generate at least a first timing signal having a given activation interval wherein L is an integer of one. Also included is a second means coupled to the first means responsive to the local clock and to the first timing signal to produce the output clock. The VCO further includes a third means coupled to the source, the first and second means responsive to the first timing signal and the phase relation between the input clock and the output clock to control the production of the output clock to follow the phase variation of the input clock.

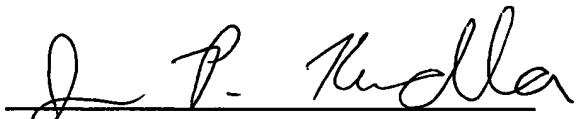
Since claims 2-3, 5 and 7-8 from independent claims 1 and 6, Applicant respectfully submits that these claims are also allowable at least for the reasons put forth in the previous section. Withdrawal of the rejections of claims 2-3, 5 and 7-8 is respectfully requested.

CONCLUSION

Applicant believes that all pending claims are allowable and a Notice of Allowance is respectfully requested. The amendment was made to expedite the prosecution of this application. Applicant respectfully traverses the rejections of the amended claims and reserves the right to re-introduce them and claims of an equivalent scope in a continuation application.

If the Examiner believes that a conference would be of value in expediting the prosecution of this application, he is cordially invited to telephone the undersigned counsel at the number set out below.

Respectfully submitted,
PERKINS COIE LLP



Dated: April 29, 2005

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